to bricks, he had occasion to make experiments in relation to the great chimney of the Edinburgh Gas-works. It became matter of consideration whether the ordinary brick could withstand the pressure of so lofty a column. Trials were therefore made with a powerful hydrostatic press, not on small specimens, but on the actual brick. The ordinary stock-brick was found to bear 140 tons on the square foot, and the common fire-brick 157 tons; but the brick of which the chimney is constructed, consisting of a mixture of fire-clay and iron-stone, bore, a single brick on its bed, no less than 140 tons—equal to 400 tons on the square foot.

The effect of the transverse strain was then considered and illustrated by various experiments and models. This strain is a compound of the tensile and compressive strain, the one part of a beam loaded in the middle being compressed and the other distended, and the beam itself becoming a lever, and acting often with enormous power against its own strength. Hence it became easy to calculate the strength, this being in every case proportional, in the first instance, to the area of the section of fracture, and this original modified by the length and depth of the beam, diminishing in exact proportion to the length, and increasing in proportion to the depth.

In a subsequent lecture, fully reported in the *Scottish Railway Gazette*, some interesting experiments were made on the tensile strength of stone from Hailes and Cragleith quarries. The Hailes stones bore on the square inch 360 lbs., the Cragleith considerably more; and a remarkable effect was observed here after the load had hung a little: it was suggested by a member to give it a slight tap with a hammer; and on this being done, it immediately snapped asunder, showing the effect of vibration or concussion when the materials are greatly strained, in aiding and completing the fracture—a circumstance which appears to throw light on what may sometimes occur by the rapid and violent action of trains on railways. The compressive strength of the Hailes and Craigleith stones was then shewn, by experiment, to be much greater than the tensile strength.

The compressive strength of posts and pillars was then considered, and the remarkable effects of the length of the pillar in diminishing its strength. On this subject much light has been thrown by the experiments of Messrs. Hodgkinson and Fairbairn. Pillars or rods were tried at different lengths, from 3 in. to 5 ft.; and of different diameters; rods ½ in. diameter, with 3¾ in. length, bore 11 tons; but, when the length was 7½ in. it only carried 5 tons; when 15 in. long, 3 tons; and, at 15 in., only 13 cwts. From these experiments a general rule may be drawn for different lengths. Taking the strength of cast-iron as formerly given at 50 tons per square inch, this will hold good in pillars till the length reaches five times the diameter, and then it begins to diminish. When the length is ten times the diameter, the strength is reduced in the proportion of 1¼ to 1; with the length at fifteen times the diameter, it is reduced as 2 to 1; twenty times as 3 to 1; thirty times as 4 to 1; and forty times as 6 to 1.

Hence the great advantage in cast-iron of using hollow pillars or tubes in place of solid metal, whereby, with the same area or section of fracture, the diameter of the pillar is increased, and with it the resistance to flexure, and an increase of strength in proportion to the length. A solid pillar, for instance, 6 in. in diameter, if extended to 7½ ft. in length, would be weakened one-half, but if cast hollow, 10 in. in diameter, and ¾ in. thick, giving the same weight of metal per ft. in length, it might then be extended to 12½ ft., and still possess the same strength as the other. In all these cases a remarkable circumstance was observed in regard to the mode of applying the strain. With the ends of the pillars turned flat, and a flat plate interposed at top and bottom, which is the case in supporting buildings, this was found to sustain nearly three times as much as when the pillar was rounded on the ends, so as to make the force pass directly through the axis, as occurs so frequently in machinery with the connecting-rods of steam-engines, and in other cases. The effect of the length of pillars in weakening the strength was illustrated by a striking experiment with a spiral wire, quite flexible, yet, when set up as a pillar, and tied in the middle latterly, with slender threads, carried a weight of 56 lbs., and would have carried much more, but the moment the threads were cut, the wire gave way by flexure, and oversetting the balance, the weight immediately sunk.

THE DRAINAGE QUESTION.

THE SEWERS, THE THAMES, AND PUBLIC HEALTH.

Sir,—Mr. Plum's scheme in THE BUILDER of June 3, for the drainage of London, "reads well," as some people say, but there are points in it which require explanation. In the first place, what does he mean by "the solid refuse of towns?" The contents of an ash-pit are solid when they enter it; but, in order to obtain anything like solidity in a cesspool, a vast quantity of fluid which enters it has to soak away or be evaporated. It is scarcely possible to imagine a case in which the refuse carried off from a house by a drain can be in any other than a decidedly fluid condition. In the next place, how is the effluvium from a street cesspool to be prevented entering the houses which drain into it? In the third place, how is that effluvium to be prevented escaping into the streets through the man-hole? In the fourth place, how many air-tight carts, how many horses, and how many men are to be employed "in the night or early morn" to carry away the contents of these street cesspools? This is a question which requires a careful answer. When once the cesspools are nearly filled, the emptying process must go on as fast as the filling process. At a rough guess, is it too much to say that there must be 3,000 carts, 3,000 horses, and 4,500 men employed every twenty-four hours in this work? In the fifth place, how high must the tops of the exit air-pipes be in order to carry off the foul air, so as not to annoy the inhabitants of London? The highest chimney-shaft of any gas-works in London is too low to prevent the neighbourhood being annoyed by the product of combustion, whether smoke, or carbonic oxide, which issues from it. Mr. Plum does not "enter upon estimates," and, therefore, I do not touch on the question of expense.

N. R.

We illustrated some time ago a cistern arranged to discharge at stated times a quantity of water into the house drains. Mr. Ashe, of Bristol, has recently patented an arrangement which has the same end in view. The inventor says:—"The apparatus is so constructed as to catch and hold all available waste water, until it amounts to about fourteen gallons, when the collecting vessel, being nearly full, suddenly overbalances, and throws the water with velocity into a conical basin, which conveys it into the eject or soil-trap, and from thence rushing through the house drain or sewer, leaves all clean and free from every nuisance."

THE CESSPOOLS OF THE METROPOLIS.

At the last census in 1841 there were 270,959 houses in the metropolis. It is known that there is scarcely a house without a cesspool under it; and that very many old houses have two, three, and more under them: so that there may be taken to be 300,000 of such receptacles. The exposed surface of each cesspool, taken on an average, measures 9 feet: and the mean depth of the whole is about 6½ feet, so that each contains 58½ cubic feet of filth. The exhaling surface of all the cesspools (300,000 × 9) = 2,700,000 feet, or equal to 62 acres nearly; and the total quantity of foul matter contained in them (300,000 × 58½) = 17,550,000 cubic feet; or equal to one enormous cesspool 10 miles in length, 50 feet in width, and 6 feet 6 inches in depth; which would extend through London, from the Broadway, at Hammersmith, to Bow-bridge over the River Lea, a length of 10 miles. If such a gigantic cesspool of filth were to be seen, it would fill the mind with horror; but, as is shown above, a vast number of small ones, which, added together, equal it in extent, is dotted all over the town—in fact, it may be said, that the ground, in old districts more particularly, is literally honeycombed with the barbarous things. From them a nasty, stinking, pestiferous vapour is constantly escaping, corrupting the atmosphere from one end of London to the other, and creating disease, misery, poverty, and other evils among the inhabitants.

J. P.

New Books.

Lessons on the Delineation of Form, intended to be preparatory to Elementary Writing, or Outline Drawing. By the Rev. CHARLES RICHSON, M.A., Clerk in Orders of the Cathedral, Manchester. With an Introduction, by GEORGE WALLIS, late Head Master of the Manchester School of Design. Darton and Co., Holborn-hill.

Fifty Diagrams, to illustrate the Delineation of Form, adapted to the Author's Lessons on the same subject. By the Rev. C. RICHSON. With a Preface, containing Hints to Teachers on the Early Education of the Hand and Eye. By GEORGE WALLIS. Darton and Co.

We have long and earnestly, as is well known, advocated the propriety and advantage of making the elements of drawing as general and primitive a branch of established and ordinary education as the elements of writing, to which drawing is much akin. And we are well assured that most of our habitual readers will rejoice with us to observe, from the titles of the little works just quoted, that our idea is at length on the likely way to a practical realization. Every one with the slightest acquaintance amongst the Lilliputian generation, must be well aware that an ambition, a positive itching, for pencil and paper, or their equivalents in any shape, however *mal-apropos*, forbidden, or inconvenient, is a characteristic feature in the intellectual constitution of nine-tenths of the whole of that interesting little class of men, and that the *delineation of* FORM, in the exercise of which they so much delight, and in the seizing of all sorts of opportunities for the display of their pride in which, they are so eager and unscrupulous, only requires the guiding hand of experience to reduce it, in multitudes at least, if not in all, to intelligibility, taste, and elegance. Here is the impetus, the steam, the locomotive, and we only want the lines, the grooves, in which it is desirable we should lead it onward to its useful destination.

In the joint productions of Mr. Richson and Mr. Wallis, there are both tact and delicacy of handling, well adapted to the tender faculties to be cultivated; and it is really interesting—we had almost said amusing—to observe the simplicity through which the young idea is fairly cajoled into the unconscious rudiments and forms of all the stern profundities of geometric lore. These truly rudimentary books, together with Mr. Wallis's forthcoming work on "The Early Education of the Hand and Eye, as applied to the Home Instruction of Young Children in the Art of Drawing," will be all-sufficient, we should think, in connection with such somewhat less rudimental or more advanced elementary books as that of Mr. Butler Williams, in teaching the imitative use of rigid and solid models, outlines of form in wire, &c., completely to accomplish the useful purpose which we have so long laboured to originate. In the words of Mr. Wallis, in his Introduction to the first of them, the two great objects in education which the little works now under notice are designed to achieve, are, to "*lay the foundation of a power to* DRAW, whilst disciplining the hand and eye in the requisite elementary *practice of linear construction as applied to* WRITING;" and we certainly think them extremely well adapted to carry out, practically and successfully, the end in view. Every national school,—every school, in fact, for ordinary instruction, ought to make, and we trust ere long will make, good and daily use of them: and as to schools for the poor in particular, the recent measures of Government, in introducing an efficient class of assistants, must now be removing the only remaining obstacle to, or excuse for the neglect of, this important subject.

Facts and Figures, principally relating to Railways and Commerce. By SAMUEL SALT. Longman and Co.

THIS is an interesting and useful little collection of extracts from newspapers, speeches, and minutes of evidence, bearing chiefly on railways, and which would otherwise be gulphed and known no more.

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